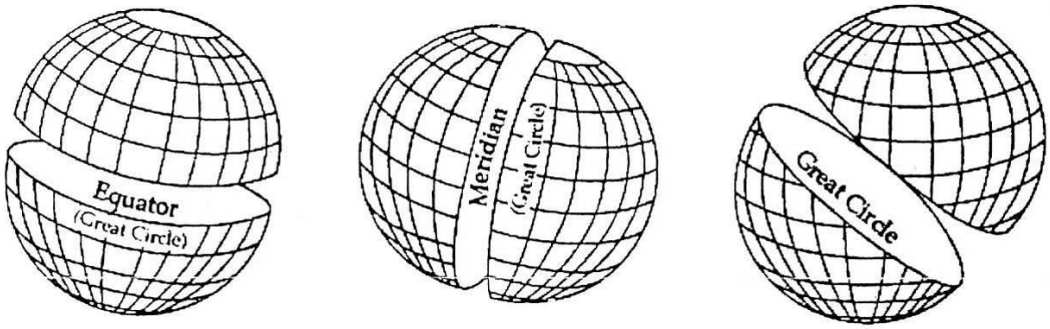
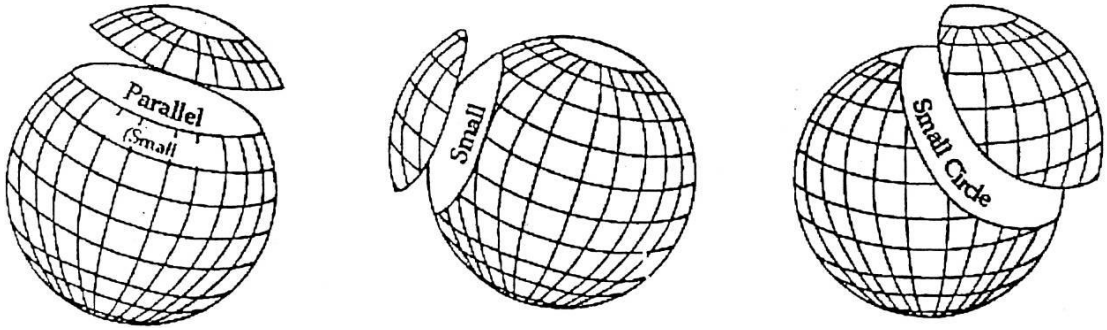
APPENDIX A: GREAT CIRCLES

The shortest distance between any two points on the surface of the earth lies along a Great Circle Route. If a perfect sphere is divided exactly in half by a plane passed through its center, the intersection of the plane with the surface of the sphere is the largest circle that can be drawn and is known as a Great Circle (Figure 1). A great circle bisects the earth into two equal halves. Thousands of such circles are possible. Examples of great circles are the Equator and the Prime Meridian when it is combined with the 180th meridian. All meridians are halves of great circles whose ends coincide with the earth's north and south poles. Although it is true that opposite meridians taken together comprise a complete great circle, it is well to remember that a single meridian is only half of a great circle and contains 180º of arc.



One should keep in mind that parallels other than the Equator are not great circles. They do not divide the earth into equal halves and are, therefore, called small circles (Figure 2).



Great circle are utilized extensively in air and sea navigation to compute the shortest distance between two points. Because most parallels do not meet the great circle criteria, navigators tend to follow other routes. Navigator-sailing routes are usually north of the parallel in the northern hemisphere. The opposite is true in the southern hemisphere. By looking at a globe, you will observe that the shortest distance between Philadelphia. Pennsylvania and Madrid. Spain (both located at approximately 40ºN) is NOT along the 40th parallel (a small circle), but rather an arc far to the north of that parallel.

A simple method to obtain the distance of a great circle route is to place a piece of string between two point on the globe, pull it tight and mark the string with a pencil or ink spot. Align the string along the Equator where the degrees are marked and determine the number of degrees between the two points on the string. One degree on a great circle (the Equator) equals 60 nautical miles or approximately 70 statute miles. By multiplying the number of degrees found on the string times 60, you can determine the great circle distance (example: 40º X 60 miles = 2,400 nautical miles). If you wish to determine the distance in statute miles, you should multiplying the number of degrees found on the string times 70 (example: 40º X 70 miles = 2,800 statute miles).

To convert nautical miles to statute miles, you must multiply the number of nautical miles by 1.15. A nautical mile is the length of one minute of latitude. This distance has been internationally adopted as 6,080 feet. British law, or statute, has fixed 5,280 feet as the measure of distance equivalent to one statute mile.